**3GPP TSG-RAN4 Meeting # 112 *R4-2413562***

**Maastricht, Netherlands, August 19th – 23th 2024**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.104** | **CR** | **0651** | **rev** | **1** | **Current version:** | **18.6.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  | | | | | | | | | | |
| ***Title:*** | [NR\_NTN\_enh\_HAPS-Perf] CR for 38.104 on PRACH format 1 demodulation requirements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson, NTT DOCOMO | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | TEI18 | | | | |  | ***Date:*** | | | 2024-08-19 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The HAPS is a deployed scenario in some regions which has large cell range (up to 100 km). NR PRACH format 1 would be the most typical format used in this scenario due to large covered cell range (~108 km), but there is no corresponding demodulation requirements in existing specifications. As requested by operators, it should be considered for adding the requirement to secure the product performance. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Adding FR1 PRACH format 1 demodulation requirements. * Adding PRACH configurations. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | There is no demodulation requirements for HAPS scenario and the access performance of the product can’t be tested. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 8.4, A.6 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **x** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **x** |  | Test specifications | | | | TS 38.141-1, 38.141-2 | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Revised from R4-2412309. | | | | | | | | |

################## Start of Change #1 ######################

## 8.4 Performance requirements for PRACH

### 8.4.1 PRACH False alarm probability

#### 8.4.1.1 General

The false alarm requirement is valid for any number of receive antennas, for any channel bandwidth.

The false alarm probability is the conditional total probability of erroneous detection of the preamble (i.e. erroneous detection from any detector) when input is only noise.

#### 8.4.1.2 Minimum requirement

The false alarm probability shall be less than or equal to 0.1%.

### 8.4.2 PRACH detection requirements

#### 8.4.2.1 General

The probability of detection is the conditional probability of correct detection of the preamble when the signal is present. There are several error cases – detecting different preamble than the one that was sent, not detecting a preamble at all or correct preamble detection but with the wrong timing estimation. For AWGN, TDLC300-100 and TDLA30-10, a timing estimation error occurs if the estimation error of the timing of the strongest path is larger than the time error tolerance given in Table 8.4.2.1-1.

The performance requirements for high speed train (table 8.4.23-1 to 8.4.2.3-4) are optional. The performance requirement for format 1 is optional and only for HAPS scenario.

Table 8.4.2.1-1: Time error tolerance for AWGN, TDLC300-100 and TDLA30-10

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PRACH | PRACH SCS | Time error tolerance | | |
| preamble | (kHz) | AWGN | TDLC300-100 | TDLA30-10 |
| 0 | 1.25 | 1.04 us | 2.55 us | N/A |
| 1 | 1.25 | 1.04 us | N/A | N/A |
| A1, A2, A3, B4, | 15 | 0.52 us | 2.03 us | 0.67 us |
| C0, C2 | 30 | 0.26 us | 1.77 us | 0.41 us |

The test preambles for normal mode are listed in table A.6-1 and the test parameter *msg1-FrequencyStart* is set to 0. The test preambles for high speed train restricted set type A are listed in A.6-3, the test preambles for high speed train restricted set type B are listed in A.6-4, and the test preambles for high speed train short formats are listed in A.6‑5. The test parameter *msg1-FrequencyStart* for high speed train is set to 0.

The test preambles for PRACH with LRA=1151 and LRA=571 are listed in table A.6-6.

#### 8.4.2.2 Minimum requirements for Normal Mode

The probability of detection shall be equal to or exceed 99% for the SNR levels listed in Tables 8.4.2.2-1 to 8.4.2.2-3.

Table 8.4.2.2-1: PRACH missed detection requirements for Normal Mode, 1.25 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Number of TX | Number of RX | Propagation conditions and | Frequency offset | SNR (dB) | |
| antennas | antennas | correlation matrix (Annex G) |  | Burst format 0 | Burst format 1 |
| 1 | 2 | AWGN | 0 | -14.5 | -16.5 |
|  |  | TDLC300-100 Low | 400 Hz | -6.6 | N/A |
|  | 4 | AWGN | 0 | -16.7 | -18.8 |
|  |  | TDLC300-100 Low | 400 Hz | -11.9 | N/A |
|  | 8 | AWGN | 0 | -18.9 | -21.3 |
|  |  | TDLC300-100 Low | 400 Hz | -15.8 | N/A |

Table 8.4.2.2-2: PRACH missed detection requirements for Normal Mode, 15 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of |  | Propagation | Frequency | SNR (dB) | | | | | |
| TX antennas | Number of RX antennas | conditions and correlation matrix (Annex G) | offset | Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -9.3 | -12.6 | -14.2 | -16.8 | -6.3 | -12.5 |
|  |  | TDLC300-100 Low | 400 Hz | -2.1 | -4.8 | -6.6 | -8.8 | 0.8 | -4.9 |
|  | 4 | AWGN | 0 | -11.6 | -14.3 | -16.0 | -19.0 | -8.7 | -14.1 |
|  |  | TDLC300-100 Low | 400 Hz | -7.3 | -10.3 | -11.7 | -13.8 | -4.3 | -10.2 |
|  | 8 | AWGN | 0 | -13.8 | -16.7 | -18.2 | -21.2 | -11.1 | -16.6 |
|  |  | TDLC300-100 Low | 400 Hz | -11.0 | -13.9 | -15.2 | -17.3 | -8.1 | -13.9 |

Table 8.4.2.2-3: PRACH missed detection requirements for Normal Mode, 30 kHz SCS

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number of |  | Propagation | Frequency | SNR (dB) | | | | | |
| TX antennas | Number of RX antennas | conditions and correlation matrix (Annex G) | offset | Burst format A1 | Burst format A2 | Burst format A3 | Burst format B4 | Burst format C0 | Burst format C2 |
| 1 | 2 | AWGN | 0 | -9.1 | -12.0 | -13.8 | -16.5 | -6.1 | -11.9 |
|  |  | TDLC300-100 Low | 400 Hz | -2.8 | -5.7 | -7.4 | -9.9 | 0.1 | -5.6 |
|  | 4 | AWGN | 0 | -11.4 | -14.2 | -15.9 | -19.0 | -8.6 | -14.1 |
|  |  | TDLC300-100 Low | 400 Hz | -7.2 | -10.4 | -12.0 | -14.5 | -4.5 | -10.4 |
|  | 8 | AWGN | 0 | -13.7 | -16.6 | -18.1 | -21.1 | -11.0 | -16.5 |
|  |  | TDLC300-100 Low | 400 Hz | -10.7 | -13.7 | -15.1 | -17.6 | -7.8 | -13.7 |

Table 8.4.2.2-4: Void

Table 8.4.2.2-5: Void

################## End of Change #1 ######################

################## Start of Change #2 ######################

# A.6 PRACH Test preambles

Table A.6-1: Test preambles for Normal Mode in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 13 | 22 | 32 |
| 1 | 1.25 | 0 | 22 | 0 |
| A1, A2, A3, | 15 | 23 | 0 | 0 |
| B4, C0, C2 | 30 | 46 | 0 | 0 |

Table A.6-2: Test preambles for Normal Mode in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A1, A2, A3, | 60 | 69 | 0 | 0 |
| B4, C0, C2 | 120 | 69 | 0 | 0 |

Table A.6-3: Test preambles for high speed train restricted set type A

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 15 | 384 | 0 |

Table A.6-4: Test preambles for high speed train restricted set type B

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| 0 | 1.25 | 15 | 30 | 30 |

Table A.6-5: Test preambles for high speed train short formats in FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A2, B4, C2 | 15 | 23 | 0 | 0 |
|  | 30 | 46 | 0 | 0 |

Table A.6-6: Test preambles for PRACH with LRA=1151 and LRA=571

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A2, B4, C2 | 15 | 164 | 0 | 0 |
|  | 30 | 190 | 0 | 0 |

Table A.6-7: Test preambles for high speed train short formats in FR2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| C2 | 120 | 0 | 0 | 0 |

Table A.6-8: Test preambles for PRACH with LRA=139, LRA=571 and LRA=1151 for 120 kHZ and 480 kHz SCS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | LRA | Ncs | Logical sequence index | v |
| A2  B4, C2 | 120 | 571 | 285 | 0 | 0 |
| 120 | 1151 | 575 | 0 | 0 |
| 480 | 139 | 69 | 0 | 0 |
| 480 | 571 | 285 | 0 | 0 |

Table A.6-9: Test preambles for normal mode PRACH with repetitions, LRA=139 in FR2-1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Burst format | SCS (kHz) | Ncs | Logical sequence index | v |
| A2, B4, C2 | 120 | 69 | 0 | 0 |

################## End of Change #2 ######################